Space Weather Technical Forecast

Issued on Wednesday, 14 December 2022 at 12:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares (R1-R2; Minor-Moderate Radio Blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar Activity is now Moderate after two recent M-flares. The first an M2 at 14/0740 UTC from 3165 (Dai/Beta-Gamma), located in the southwest, the second an M1 from departing region 3153 at 14/0830 UTC.

There are ten sunspot regions on the Earth-facing disc, although most of these are small and simple with little sign of development. The most notable regions are AR3167 in the north-centre, AR3163 in the southeast and AR3165, already mentioned above. AR3167 (Dso/Beta) in the north centre disc is a relatively simple with an east-west magnetic configuration, and appears to have shown some minor decay in recent imagery. AR3163 (Ehi/Beta) in the southeast is also of reasonable size, showing further growth in its smaller intermediate and trailer spots, and is dominated by a moderately sized leader spot. AR3165 shows further spot growth.

No Earth-directed CMEs have been observed in available imagery. However, a filament lift off from the southwest of the Earth facing disc, commencing around 14/0300 UTC is currently being modelled but imagery indicates this is largely directed towards the south, so no significant impacts are anticipated at present. Another CME is emerging off the west limb following the M1 flare from AR3153, but this is directed well off to the west. Analysis will be undertaken once updated imagery allows, but no impacts are expected from this event either.

Solar Wind / Geomagnetic Activity: Solar wind speeds, as observed at L1 by DSCOVR and ACE has declined gradually from 400 km/s to around 340 km/s. Density was mostly below average. The total IMF, Bt, was weak, below 7nT. The north-south component of the IMF, Bz, varied weakly between -3nT and +4 nT. Phi angle was negative (towards the Sun) throughout. Geomagnetic activity was Quiet (Kp 0-1).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 remained at Background levels. High energy electron flux (greater than 2 MeV), as observed by GOES16, has been at Background to Moderate levels, with peak 370 pfu at 13/1710 UTC. The associated 24-hour fluence remained steady, and well below Active (1e8 integrated pfu). Observed fluence at 14/0000 UTC was 8.89e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to continue mostly Low, but with a chance (40%) of further M-class flares (R1-R2 Radio Blackouts), most likely from AR3165.

Solar Wind / Geomagnetic Activity: There are currently no Earth-directed CMEs expected. Solar winds are expected to remain at Background to Slightly Elevated with no notable enhancements anticipated. Quiet geomagnetic activity expected with only a slight chance of

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isolated Unsettled intervals.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels throughout. There is a very slight chance of rising towards the S1 level with the occurrence of any notable flares. High energy (greater than 2 MeV) electron flux is currently at background to moderate flux levels, with only a slight chance of briefly reaching High levels each day. The associated 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) threshold.

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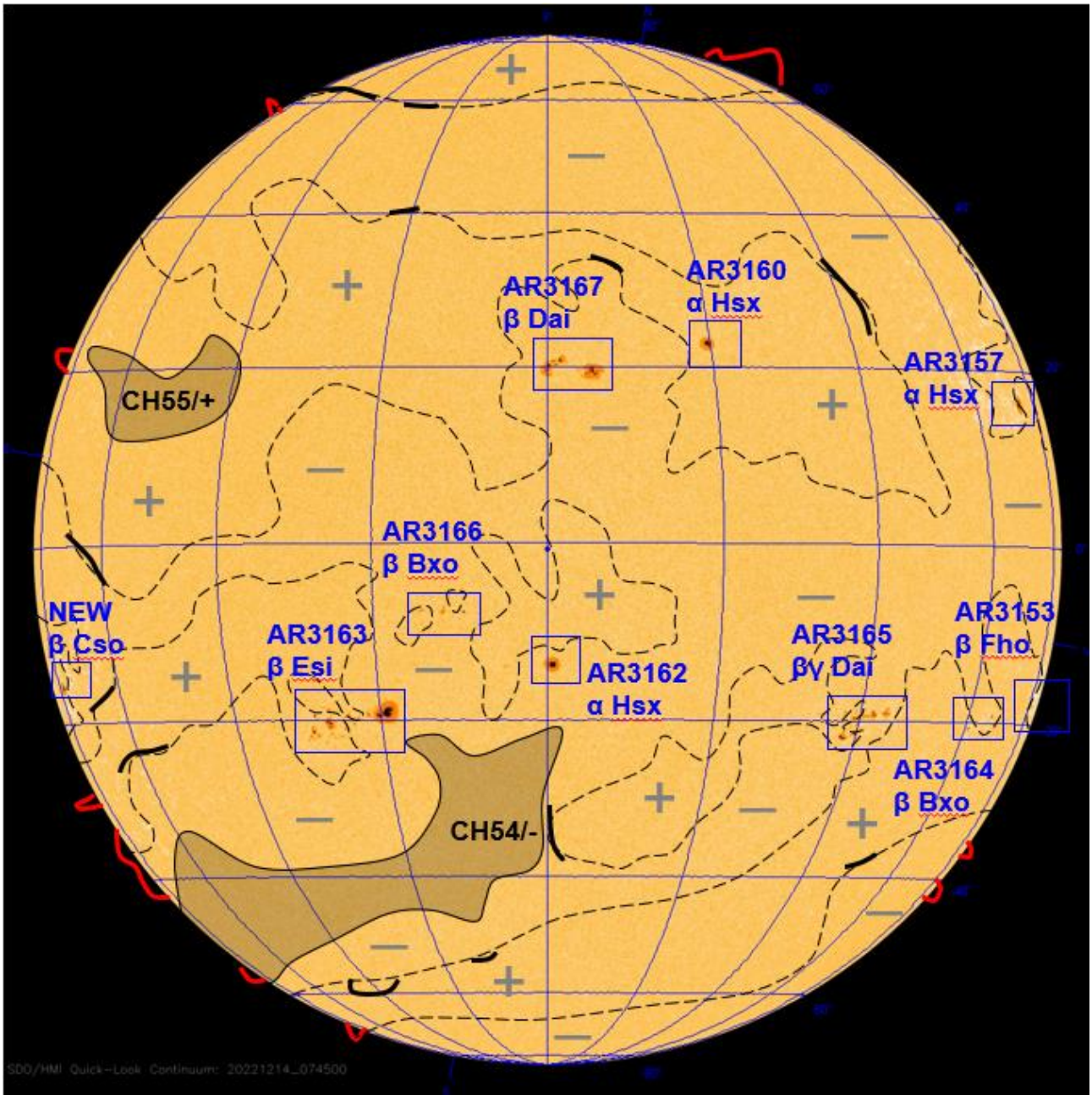
Figure 1. Solar Analysis Valid 14/0800 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are currently no Earth-directed CMEs expected. A filament lift off from the southwest, commencing around 14/0300 UTC is currently being modelled but imagery indicates this is directed largely toward the south, so no significant impacts are anticipated at present. Another CME is emerging off the west limb following the M1 flare from AR3153, but this is directed well off to the west. Analysis will be undertaken once updated imagery allows, but no impacts are expected from this event.

Solar winds are expected to be at background to slightly elevated, with no significant enhancements forecast. While MOSWOC enlil does suggest the possibility of some connection to the fast wind, likely due to a now impossible to see CH in the northwest disc, this has been discounted due to enlil verifying poorly to current conditions. It is likely that any such fast wind, if it was there, is passing above the Earth. This is supported by the lack of enhancement observed at STEREO A, which is 1 degree north of the ecliptic whilst Earth is currently at 1 degree south. Quiet geomagnetic activity expected with only a slight chance of isolated Unsettled intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

None expected.

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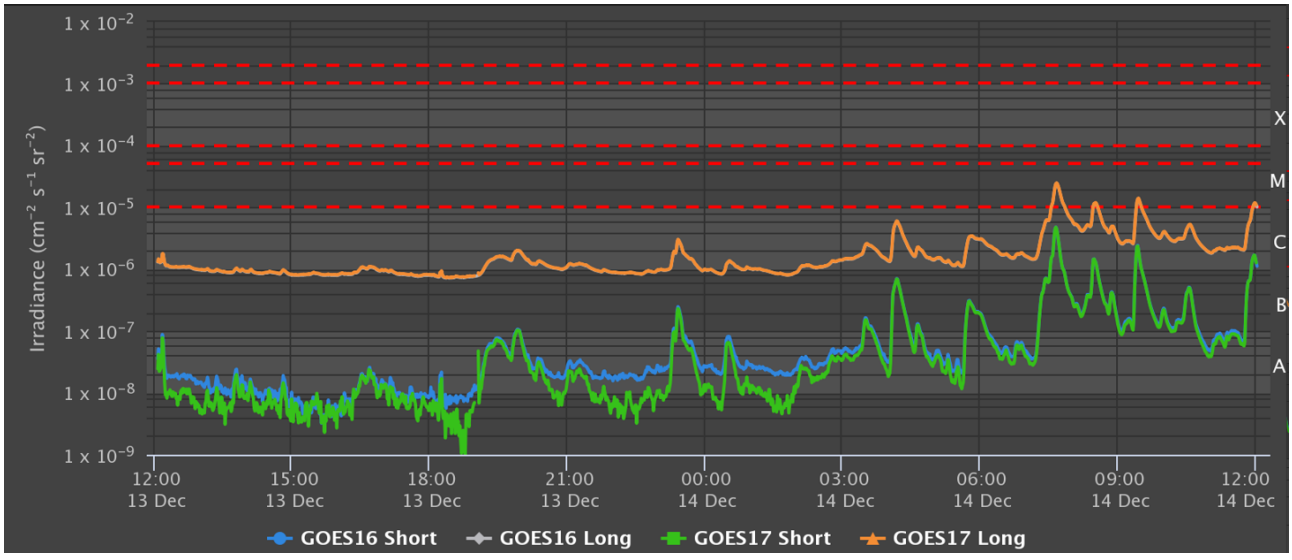
Radio Blackouts - X-Ray Flares:

There are a total of ten sunspots on the Earth-facing disc, however the vast majority of these are small and simple with solar activity likely to be mostly Low, although with a chance of further Moderate flares, most likely from AR3165. This is one of three main spot groups of interest. AR3167 in the north centre disc is a relatively simple with an east-west magnetic configuration, and appears to have shown some minor decay in recent imagery. AR3163 in the southeast is also of reasonable size, showing further growth in its smaller intermediate and trailer spots, and is dominated by a moderately sized leader spot. AR3165 in the southwest is slightly more magnetically complex, recently producing an M2 flare at 14/0740 UTC. In addition to these three regions of interest, the large region AR3153 has rotated to the west limb, with only the trailer spots now visible, however this also produced an M1 flare at 14/0830 UTC.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 2: GOES16/17 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 is expected to remain at background levels throughout. Despite their magnetic relative simplicity, the number of sunspots on the Earth-facing disk, and especially in the western hemisphere, give a daily chance of M-flares. This subsequently gives a slight chance of the proton flux increasing due to any such flare activity, and perhaps approaching or exceeding the S1-level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy (greater than 2 MeV) electron flux, as observed by GOES-16, is currently varying between Background and Moderate levels. With no significant solar wind enhancements expected, these electron flux levels are expected to persist through the period, with only a slight chance of briefly reaching high at the diurnal observation peak.

The associated 24 hour fluence is forecast to persist below the active threshold (1e8 integrated pfu). This is supported by REFM which is currently giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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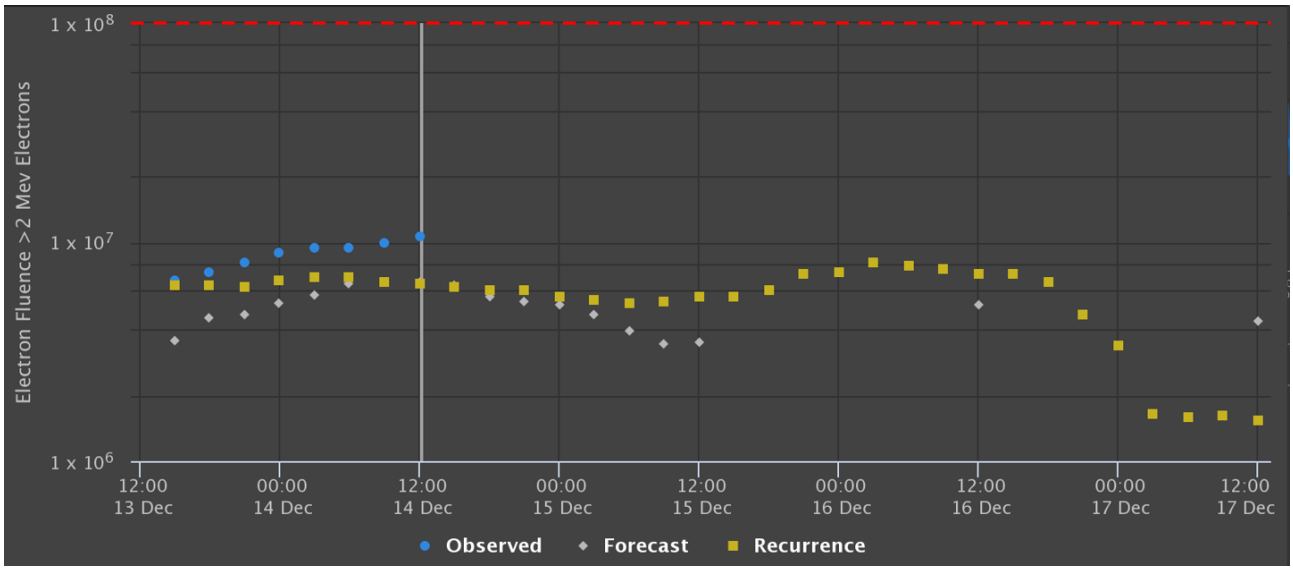
Figure 3: MOSWOC REFM output



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